the influences of two very different sets of conditions, while the latter has been led by it to a single fixed form suitable to a single set of conditions. This is only a suggestion, and might require modification after a special study of the circumstances of the two species; but it is sufficient to show that we require far more evidence before it can be conceded that such transmission had been made in any way probable.

The book is well and clearly printed. A portrait of Lamarck forms the frontispiece. E. B. P.

THE RATIONAL TEACHING OF MATHEMATICS.

The Teaching of Elementary Mathematics. By David Eugene Smith, Principal of the State Normal School at Brockport, New York. Teachers' Professional Library. P. xv + 312. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1900.)

IN many training colleges for primary school teachers there are elaborate courses of study on psychology and ethics. Surely a knowledge of morals and of the mental machinery of boys and girls would be more certainly and more easily acquired incidentally during other studies, such as the natural sciences; but at these colleges there is seldom any attempt to educate through the natural sciences. We have, though not to the same degree, the same feeling about courses of instruction in mathematics. There is a cold-blooded formality about the mere name which tells all children truly that they are being offered stones for educational bread. But if there must, unfortunately, be separate courses of instruction in mathematics, we should, if we were children, dearly love to be taught by Mr. Smith. He is well read in his subject, and teachers who are also well read will take pleasure in seeing the best views so clearly put forward; teachers who are not learned in the subject will benefit greatly by reading this book. Short sketches of the histories of arithmetic, algebra and geometry are woven into the text in such a pleasant fashion that one reads and understands without much effort. The merits and demerits of various systems of teaching mathematics to very young children are clearly stated, but we cannot help thinking that too much is made of the philosophy of the numerous German exponents of pedagogy. There is no system which will give good results in the hands of a fool; there are many systems which will work fairly well in the hands of the average teacher; a thoughtful man who is in sympathy with his pupils will succeed with any method that he is likely to adopt.

Philosophers are too fond of distinguishing between teaching for *utility* and teaching for *culture*. We take it that even if we teach mathematics for its "bread-and-butter-value," if we teach so that a pupil really understands what he does, then we are really training his logical powers and giving him help in his ethical, religious and philosophical ways of thinking. The more we try to teach merely for culture the more do we make the reasoning obscure and difficult. As if a good teacher could possibly give sordid notions to his pupils! What we really want is that all teachers shall know their business, and then, however quickly they may make their children cover the ground of elementary mathematics, and we say the quicker the better, the children will be taught as rational beings. Much of the arithmetic taught in schools is really the teaching of a trade. A particular rule like *Practice* is merely the application of arithmetic to the trade of a grocer. So also rules like *Interest* or *Discount* are labour-saving rules, useful when one has thousands of calculations of the same kind to make, easily learnable by a boy after he leaves school if he has a knowledge of simple arithmetic and if his common sense has had a fair chance of development. Children may be kept for years at "rules" of arithmetic which they never understand, by an unscientific teacher, and this is what the philosophers condemn as utilitarian teaching. There is as little *utility* about such teaching as there is *culture* in that of the equally unscientific follower of the greatest psychologist. Of the two, however, the unscientific utilitarian does least harm, for he makes least pretence; he only stupefies the brain, the other destroys the soul.

Indeed, the man who aims exclusively at culture always hurts the soul of his pupil, for he teaches that what is useful must be low, and that the study of it must lead to sordid thought. We can no longer afford to laugh when men assure us that they scorn the results of their studies when these results prove to have useful applications. So long as these men were few in number they might be laughed with; we laughed because they were paradoxical and because we did not fear that the utility of a study could really be lost sight of. We are always grateful to philosophers who discover new truths, whatever their notions as to their utility may be. But when the stupid admirers of these men erect their paradoxes into articles of belief; when headmasters with much capital invested in teaching machinery find that such articles of belief give a fictitious value to their invested capital; when as a result, 98 per cent. of the boys leaving school at seventeen to nineteen years of age know no mathematics, although they are supposed to have been studying mathematics for many years; when we have overwhelming proof from the fields of war and commerce and manufacture that the best race of men in the world is held by want of education, as if by enchantment, from exercising its natural powers—then we feel that the time has come when a crusade ought to be preached against the pestilent heresy.

We are very glad to think that Mr. Smith gives great weight to the opinions of Profs. Henrici and Minchin about mensuration and geometrical teaching. Lacroix expressed them clearly, so did Clairaut and Voltaire and Hoüel and Spencer and Langley, and many another educationist. Laisant says, "But just as there must be a preliminary preparation for arithmetic—namely, practical calculation—so theoretical geometry should be preceded by the practice of drawing." Rousseau said that for young pupils "geometry is merely the art of handling the rule and compasses." Mr. Smith describes the use of shears and cardboard, and he suggests how to follow Galileo's experimental and inductive methods in mensuration, even with boys of intermediate grades. As for demonstrative geometry, Mr. Smith says that in America it usually begins in the tenth or eleventh school year.

"To begin a work of the difficulty of Euclid any earlier than this will hardly be sanctioned by American teachers; the hard Euclidean method must change, or the subject must remain thus late in the curriculum. If the object were, as seems to be the case in England, to cram the memory for an examination, it could be attained here as easily as there. But the considerable personal experience of the writer, as well as the far more extended researches of others, convinces him that as a valuable training in logic, as a stimulus to mathematical study, and as a foundation for future research, the study of Euclid as undertaken in England is not a success."

He then quotes Prof. Minchin, who says:—

"Why then is it that the teacher, when he comes to the teaching of Euclid, is confronted with such great difficulties that his belief in the rationality of human beings almost disappears with the last vestiges of that good temper which he himself once possessed? The reason is simply that Euclid's book is not suitable to the understanding of young boys."

We wish that Prof. Minchin had gone further and said that whereas every boy and man takes an interest in experimental science, including geometry and mensuration, only a few ever take an interest in demonstrative geometry; and it is both wrong and foolish to insist on its being learnt by boys whom it stupefies, whatever their age may be. All educationists are agreed that the English system of insisting on all young boys learning demonstrative geometry is quite wrong. Certainly, we know of no educationist who has a word to say in favour of the system prevailing in all English schools. We take it that the system is maintained because it does not "pay" the pupil in any sense whatever. Prof. Hudson is quoted as saying, "To pursue an intellectual study because it 'pays' indicates a sordid spirit." Working at geometry indicates no sordid spirit in our boys, but we are not so sure as to what it indicates in the masters of English schools. It "pays" them very well indeed.

Give the brains of an average English boy a chance of development, and he is full of common sense and self-reliance and scientific method; and yet the average boy leaves our schools uneducated, with no knowledge, and with the belief that he is stupid. Even Pythagoras did not think that more than a very few men were capable of the study of geometry; hardly one legislator or ruler or warrior from the time of Pythagoras to that of Pappus made a study of geometry, although this was a time when there were few kinds of intellectual study.

Mr. Smith's statements as to the history of the subject are fairly acceptable, as he keeps clear of debatable matter.[1] Throughout, he is unwilling to give Semites much credit, and I presume that it is in consequence of this that, in describing the work of Diophantus, the Alexandrian beginner in what we now call algebra, he forgets to mention that in all probability all the early life of Diophantus was spent among Asiatic peoples. Algebra, as we know it, dates from the time of Haroun of the "Arabian Nights." No doubt it comes altogether from the Semites of thousands of years before—the Semites who gave us all religions and the usages of older civilisations, without being able to give us their own subtler instincts; who taught Homer the decoration of a shield and Pericles how to beautify Athens; who gave Greece all its geometry through Pythagoras the Tyrian; who allowed Thales and Herodotus and other peripatetic students to absorb their science; who taught the doctrine of humanity to Socrates, and who did not mind taking to themselves Aryan names either in Troy or Alexandria or London.

The earnest reader of Mr. Smith's book will probably be led by it to think things out for himself. It is not important that he should subscribe to the author's opinions. Indeed, these opinions are rather in opposition to one another, for Mr. Smith is able to see that there is much to be said in favour of the views of almost all the writers whom he quotes. He gives many hints which will be found very suggestive by a thoughtful teacher of arithmetic and algebra who is not himself a good mathematician. They may, however, lead a common man to obscure the minds of his pupils, giving them, for example, all the historical methods of solving quadratics before they know much about quadratics. When one clears an equation of fractions by multiplying all across by some function of the unknown, the resulting equation contains other roots than the original one—yes, but it is not wise to trouble beginners with too much of this. One may philosophise deeply over our very simplest notions, but "Sartor Resartus" ought only to be read by grown-up people. JOHN PERRY.

[1] As this notice was getting too long, we have cut out much of what we had written. We have here cut out some remarks as to the claim of Napier of Merchiston to the invention of the use of decimals. But it is rather important to re-write an observation made long ago by Prof. Ayrton:—"The units ought to be symmetrical with regard to tens and tenths, and it would be more scientific to write 1500·0032 as 15000032 or 15060032, or in some other way which shows its symmetry. It is astonishing what trouble is given by the difference in rules between finding the logarithm of a number like 500 and a number like 0·05. If they were written 506 and 605 we should have the same rule for both. If we must retain the present unscientific method, let writers who wish to avoid printers' errors avoid ·05 and always write 0·05."

HUMAN ORIGINS.

In the Beginning (*Les Origines*). By J. Guibert, S.S. Translated from the French by G. S. Whitmarsh. Pp. xvi + 379. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1900.)

THE author of this book is the Superior of the Institute Catholique in Paris, but when he wrote it he was professor of natural science at Issy. The book is the outcome of an endeavour to train young ecclesiastics who, in the future, would have to propagate and defend the faith. It is rightly insisted as most essential that young clerics should be wanting in no knowledge concerning humanity; and it is pointed out that two perils of equal danger have to be avoided—an ill-founded compliance with the theories in favour amongst the learned, and a blind attachment to certain ideas which have no firm foundations, but which some men erroneously consider as identical with the faith. The author imposes on himself the three following obligations: (1) honestly to explain systems, (2) assert with firmness what is well established, (3) leave the questions open which have not yet received a solution; and he concludes his preface thus:

"If, as science advances, it should illuminate some doubtful point, or show the fallacy of some solution which I had looked upon as finally settled, I should not hesitate to yield myself to these indications. And if the Church, in whose infallibility I firmly believe, should deliver a judgment contrary to my assertions, I am ready, in advance, to accept her teaching."